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NASA TECH BRIEF

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High-Power Microwave Power Divider Concept

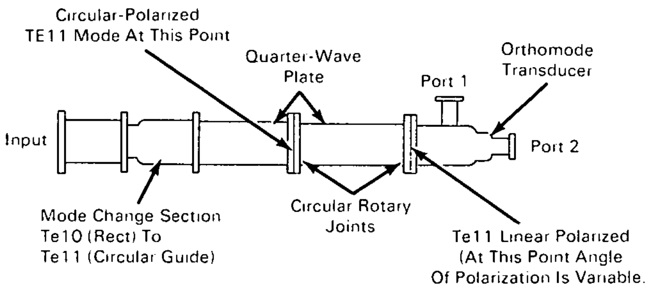

Figure 1

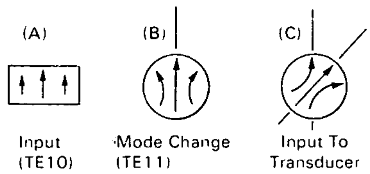

Figure 2

The problem:

Operation of a microwave transmitter occasionally requires a considerable reduction in power output in typical situations as: close range testing, or simulating flight conditions by continuously reducing the power to the XMTR antenna; common practice is to reduce the drive to the last power stage, hence, degrading the performance. Bandwidth and modulation characteristics are appreciably affected.

The solution:

This innovation is a concept of a variable power divider for the output of a microwave transmitter. By use of this device, a microwave transmitter may remain at full power, hence, preserving the bandwidth and modulation characteristics, and proportion any amount of the full power from the normal antenna into a dissipative load.

The divider consists of four elements: a transducer which changes the polarization from rectangular to circular; two quarter wave rotatable plates which change circular polarization to rotatable linear polarization; an orthomode transducer distributing power to two output ports. The ratio of distribution is determined by the angle between the two quarter wave plates.

How it's done:

The high power microwave power divider is shown in Figure 1. The power into the mode change section from the TE_{10} mode in the rectangular waveguide to the TE_{11} mode in the circular waveguide is converted to TE_{11} circular polarization by the first quarter wave plate. By rotating the second quarter wave plate with respect to the first, rotatable linear polarization is obtained at the output of the second quarter wave plate which is connected to the fixed (relative to input) orthomode transducer. The power into each port is a function of the polarization angle of

(continued overleaf)

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the incident wave and is controlled by the rotary setting of the second quarter wave plate.

Let us define 0 degrees as the direction of polarization at the input port as shown in Figure 2A. The mode is changed to the TE_{11} circular polarization in the mode change section and the first quarter wave plate. This is shown in Figure 2B. The circular polarization is changed to rotatable linear polarization by means of the second quarter wave plate and is rotatable through 360 degrees. This input to the orthomode transducer is shown in Figure 2C. The amount of power distributed to load 1 or load 2 depends upon the angle θ setting of the second quarter wave plate. The power into load 1 (P2) is:

$$P2 = P_{input} \ \mathrm{Cos}^2 \theta$$

The power into load 1 (P1) is:

$$P1 = P_{input} \ \mathrm{Sin}^2 \theta$$

Therefore, the attenuation from input to Port 2 is:

$$A_{(db)} = 10 \log \mathrm{Cos}^2 \theta \quad \text{or} \quad A_{(db)} = 20 \log \mathrm{Cos}\ \theta$$

Attenuation is a function only of the rotation angle and could be remotely read and controlled.

Note:

1. This development is in conceptual stage only, and as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.
2. No further documentation is available.

Patent status:

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